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Application of the Certainty Factor Method for Mobile-Based Identification of Freshwater Fish Diseases

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Abstract

Freshwater fish its the food sources with profitable sales, consistent care can achieve the maintenance process until successful. Freshwater fish that have a high selling value include Gurami and Catfish. Gurami fish sales per seedling Rp. 3,000 and Lele fish sales start from Rp. 1000 to Rp. 0.500. Fish care needs to be considered to maintain its quality. Various problems are also experienced by farmers. The slow identification process makes fish affected by the disease faster and loses. Several factors inhibit the fish is of illegal drugs, overfeed, and environmental unhygiene conditions. The role of experts that is not sufficiently available makes limited information about controlling fish diseases so that it takes time and costs little. Utilizing technological progress, expert systems can help to solve problems that previously could only be solved by an expert. The Forward Chaining Method is a method on an expert system that is able to do a reasoning with advanced forward techniques. The Certainty Factor method is a method that can give a degree of confidence in a disease. An expert system built to identify freshwater fish diseases was built into the deep android operating system by the Waterfall development method. Data taken includes as many as 10 symptom data and 29 disease data implemented into the system. With this expert system in place, it aims to provide benefits to facilitate access in adding information about fish diseases so that countermeasures become faster.

Keywords: Expert System, Freshwater Fish, Forward Chaining, Certainty Factor

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1. Introduction

Freshwater fish cultivation businesses are growing along with the high production of fish as the main food source. Fish such as gourami, catfish and tilapia are superior choices in this cultivation because they are not only popular for consumption, but also have high nutritional content. This development is in line with the verse in the Qur'an Surah Fatir verse 12 which describes the difference between two types of sea, where fresh water is said to be a source that is fresh and delicious to drink. Tafsir Riyadh emphasizes that quality fish meat can be obtained from fresh water, emphasizing the blessings and health benefits contained in cultivating freshwater fish (Arie & Dejee, 2013).

The translation of this verse provides a deep understanding that freshwater fish are not only a source of sustenance, but also a wise choice for the welfare of the people. The high nutritional content in freshwater fish is an incentive to maintain the quality of cultivation, ensuring that the fish produced remains of high quality and is suitable for consumption. In this way, freshwater fish cultivation is not only a productive economic field, but also reflects an understanding of the blessings of nature as mandated by God.

Freshwater fish farming has become a source of income that has increased over time, especially because sales at relatively low prices attract buyers. To maintain market attractiveness and fish quality, consistent care for fish health needs to be paid attention to by freshwater fish farmers. Research conducted regarding freshwater fish harvests shows that sales range from 6 to 10 fish per kilogram, with consumers generally buying fish in the range of 8 to 10 fish per kilogram. Restaurants are the main buyers, especially for gourami and catfish, with the cultivation of gourami and catfish reaching 300 fish every 3 months (Tama, 2023).

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Even though the cultivation process produces profitable results, breeders also face various problems that can hinder the cultivation process. Factors such as disease attacks, excessive feeding, and the cleanliness of the pond environment are the main challenges. For example, excessive feeding can cause build-up that poisons ponds, creating an unhealthy environment for fish. This can result in infestation with parasites, bacteria or viruses which can reduce the quality of the fish and have a negative impact on sales of freshwater fish farming products. Therefore, paying attention to these aspects in the cultivation process is important to maintain the success and quality of freshwater fish cultivation businesses.

The emergence of disease in fish, especially due to parasites that require a host, is a challenge in cultivation. Farmers need adequate handling information, but limited access and distance prevent direct observation of fish symptoms. The disease identification process becomes slow, while fish health must be addressed quickly. Even though technology is not yet fully effective in handling, technological developments, especially access via smartphones, are expected to make it easier for cultivators to care for and maintain fish health more quickly. In this context, Allah's command in the Qur'an to the Prophets Dawud and Solomon to develop technology such as armor and control of the wind shows that Islam encourages the use of science and technology for the good of humanity (Nurcahyo, 2018).

The existence of technological teachings in the Qur'an reminds humans of their responsibility to develop knowledge and technology. By wisely using technology, it is hoped that fish farmers can overcome the obstacles of disease identification and quickly take the necessary actions, so that fish health is maintained in their cultivation efforts.

Previous research is used as a benchmark for researchers to analyze research. Namely, in research conducted by Borman et al in 2020 in the journal entitled "Implementation of Certainty Factor in Overcoming Uncertainty in Marine Disease Diagnosis Expert Systems" this research aims to diagnose seahorses using the Certainty Factor method. This method is able to overcome uncertainty by defining the level of certainty based on facts so that it can explain an expert's beliefs. The research results show that the application of the Certainty Factor method in diagnosing seahorses has an accuracy rate of 86.6%, which is said to be successful, which was obtained from an accuracy test by matching the diagnosis from expert analysis and the diagnosis produced through the system. This research used 15 cases randomly assigned to an expert system and seahorse disease experts, then the results were compared so that the system was able to answer 13 cases (Borman et al., 2020). Further research was carried out by Prianto in 2019 in the journal entitled "Expert System" for Diagnosing Diseases and Pests in Pepper Plants Using the Android-Based Forward Chaining Method. In this research, the Forward Chaining method in its search technique starts from known facts and then matches these facts with rules so that this method is able to provide accurate solutions to existing problems according to the symptoms present in the plant. The testing method achieved an accuracy of 97.14% and worked well, where the accuracy results were carried out by testing 35 data and obtained 1 result that did not match the expert. To increase the level of accuracy, validation must be carried out by more than one expert so as to provide better accuracy (Prianto et al., 2019).

2. Literature Review

2.1. Artificial Intelligence

Artificial intelligence is one of the sciences in the field of computers that refers to the design of computer systems by providing human reason so that the system can interact and imitate human behavior (Agusta & Harits Ar Rosyid, 2019). Human intelligence embedded into the system can provide benefits for humans such as facilitating work to be faster and not draining a lot of energy to complete it (Yuvidarmayunata, 2018).

2.2. Expert System

An expert system is a computer program technology that contains knowledge in a particular field sourced from an expert or expert. Expert systems include disciplines in the field of artificial intelligence where the process requires human knowledge, namely expert knowledge is represented into the system so that it can help solve more specific problems (Hasibuan et al., 2017).

2.3. Freshwater Fish Farming

Freshwater fish farming is the production activity of raising and raising fish whose environment is in inland waters where waters with salt levels of less than 5 per mile freshwater fisheries are found inland where the water is very fresh. The history of Indonesian waters in fish farming in ponds and ponds has long been applied for generations. Fish farming

has been done to provide for themselves and supplement family income since the 14th century. This history is evidenced by the existence of old archives in the form of letters from the Surabaya Resident to the Board of Finance showing that in 1821 in Surabaya and Gresik there had been a pond business that had implemented tax payments (Wijayanti, 2020).

2.4. Fish Diseases

The definition of fish disease is everything in the body of the fish that reacts to experience a disorder that can make fish suffer to cause death. Fish disease is one of the big problems faced by fish farmers, especially freshwater fish raised in artificial ponds. There are three factors that influence the occurrence of disease in fish, namely the fish itself, the environment, and pathogens. If there is an imbalance, it can cause illness and death (Nur, 2019). Indonesian waters have recorded several cases of fish diseases including in 1971 cases of fish infected by parasites Lernea, and bouts of infection Myxosomain 1979 that infects freshwater fish. This disease attack is a dangerous disaster for fisheries because fish sustainability needs to be maintained to maintain the stability of fisheries. (Nur, 2019).

Figure 1. Enteric Red Mouth Disease (Source: Personal document)

2.5. Forward Chaining Method

Method *Forward Chaining* Including methods that exist in the expert system. This method can be used to make a diagnosis or give conclusions based on the facts of the facts proposed. The procedure is formed sequentially and then collects evidence, after *evidence* Collected then a conclusion is given. There are many areas on expert systems that use methods *Forward Chaining*, such as Agriculture, Health, Education, and Sociology (Maulida et al., 2023). Conditions are met on the application of the Method *Forward Chaining* If you already have data, namely in the form of facts that have occurred. The facts that have been collected should have fulfilled a conclusion to the point that they can be called rules (*Rule*). Section facts *IF* What is collected will be tested for correctness by adjusting through rules *IF THEN* to come to a conclusion (Triawan, 2021).

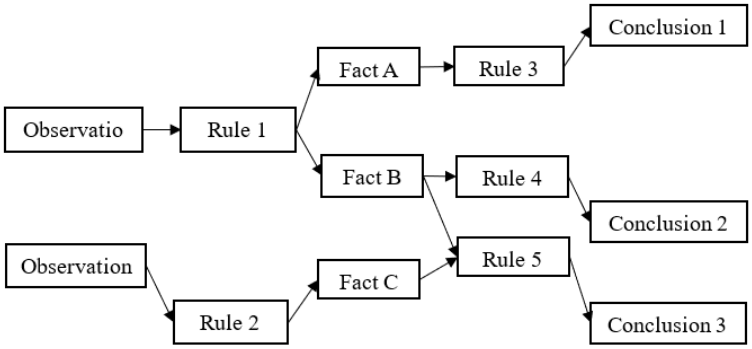

Figure 2. Method Search *Forward Chaining* (Triawan, 2021).

Examples of cases of tracing the *Forward Chaining* method in finding a conclusion based on rules (*Rule*) as follows:

Rule 0. **IF the** movement of the fish slows down, appears floating, and appetite decreases **THEN** the fish gets the disease.

Rule 2, IF brightly colored body THEN the fish is in good health.

Rule 3, IFoften rubs the body against objects THENfish attacked by disease

Rule 4, IF the fish moves actively, appetite increases THEN the fish is in good health.

2.6. Certainy Factor Method

Method *Certainty Factor* is a method in the application of expert systems that aims to measure between a sense of confidence and uncertainty in the face of uncertain problems. Method *Certainty Factor* was first introduced by Shortliffe Buchanan in 1975 in the manufacture of MYCIN. This method developed gradually through the development of the MYCIN expert system in which doctors initially analyzed information about a symptom were concluded with expressions such as possible, most likely, almost certain, and certain. By method *Certainty Factor*, can accommodate uncertainty by describing the level of confidence of an expert in dealing with the problem of diagnosis. The results show a measure of certainty to a fact. There are positive values and negative values, positive values are the highest values expressed (Anik, 2020).

The *Certainty Factor* method in its formula can be defined as follows:

$$\boldsymbol{MB\ (H,E) = \begin{cases} \dfrac{\boldsymbol{max\ p\ \langle P(H|E), P(H|E) - P(H)\rangle}}{\boldsymbol{max\ [1,0] - P\ (H)}} & \boldsymbol{P(H) = 1} \end{cases}}$$

$$\boldsymbol{MB\ (H,E) = \begin{cases} \dfrac{\boldsymbol{max\ p\ \langle P(H|E), P(H|E) - P(H)\rangle}}{\boldsymbol{max\ [1,0] - P\ (H)}} & \boldsymbol{P(H) = 0} \end{cases}}$$

$$\mathbf{CF = MB(h,e) - MD(h,e)\ (h,e)}$$

The equation above is one form of the application of *Certainty Factor* which is formed into Certainty *Theory*.

Information:

CF(h,e) = Certainty factor

MB(h,e) = A measure of confidence or level of confidence in the hypothesis h if influenced by evidence.

MD(h,e) = A measure of distrust or uncertainty of a hypothesis if influenced by evidence.

2.7. Waterfall Method

Designing an application requires a method in the design stage. The development method aims so that the application built can run well. One method that can be used in the process of developing an application is the Method Waterfall Or in Indonesian means waterfall method, which is likened to a waterfall down where the process is in the method Waterfall carried out gradually and sequentially. Waterfall method Carried out gradually and sequentially to facilitate the control of the development process in an arranged manner so as to minimize errors that occur in an application. The advantage of any of these development methods is a clear and measurable set of workflows. In addition, this Waterfall method can save costs in its development because each stage can be explained well (Susilo, 2018). The waterfall method of this study shown on Figure 3.

2.8. Android

Android is operating system based Linux which can be used on smartphones (Smartphones) (Rafi Aziz et al., 2019). OS Android is the most widely used operating system because it provides platform Open for developers to build applications called applications Mobile. Android is the operating system embedded in Gadgets, be it Mobile, tablets, are also now venturing into digital cameras and watches. Android Inc. and Google Inc. Collaborate to collaborate on

operating system development Android. Android First released in 2007 and the first phone to use the operating system Android be HTC Dream in 2008 (Gunawan et al., 2021).

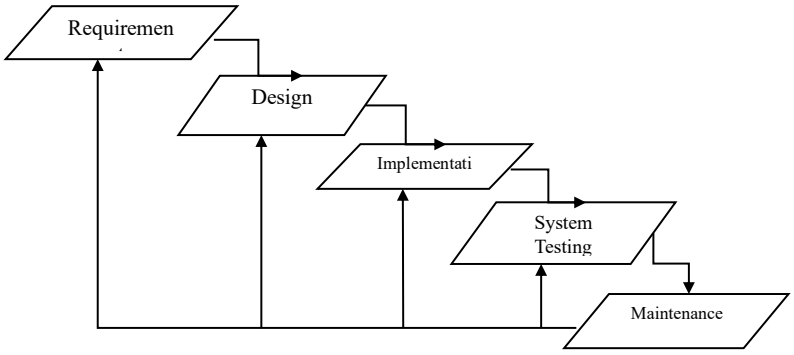

Figure 3. Waterfall Method Flowchart (Susilo, 2018).

Figure 4. Logo on Android Source: www.android.com

2.9. Flowchart

A flowchart is a series of flowcharts in which each symbol has its own function. Flowcharts are used as a representation of the algorithm explanation so that it can facilitate understanding of how the flow of the algorithm works. Each symbol of the arranged symbol is connected by a line with arrows that can indicate the flow on the diagram. Flowcharts are important to draw before modeling a system so that all designs are arranged (Irawan, Dedi, 2022). Creating a flowchart is the first step in compiling a design, where the flowchart serves to provide an overview of the process and document the process so as to ensure the program is made according to the flow.

3. Research Method

This research was carried out at the Marine and Fisheries Office of Langkat Regency and in the trading business of freshwater fish farmers during the even semester of 2022. As research materials and tools, the use of hardware includes laptops and smartphones, while the software used involves the Java programming language, Windows 10 Home Single Language 64-bit operating system, and Android Studio. The research planning process is carried out by utilizing the Android Studio application. The data collection method involves literature, observation, and interviews to gain a comprehensive understanding of conditions on the ground. In the design stage, the waterfall approach is used to set the stages of application development, while the Certainty Factor Method is used to evaluate the success of implementation. The display aspect of the application interface will be designed with the Interface method to ensure optimal user engagement. Thus, this research method is expected to provide accurate and in-depth results in analyzing and developing applications that focus on freshwater fish farming in Langkat Regency.

4. Result and Discussion

4.1. Disease and Symptom Data

The following is information data on the disease and accompanying catfish and carp obtained after data collection

Table 1. Fish disease data

No	Code	Disease Name
1	P1	Brainchiomycosis
2	P2	Columnaris
3	P3	Vibriosis
4	P4	Enteric Red Mouth
5	P5	White Spot
6	P6	Tuberculosis
7	P7	Thricodiniasis
8	P8	Chilodonella
9	P9	Channel Catfish Viruses Disease
10	P10	Mychrobacteriosis

In table 1 there are 10 types of fish diseases, namely Brainchiomycosis Columnaris, Vibriosis, Enteric Red Mouth, White Spot (White spot), Tuberculosis, Thricodiniasis, Chilodonella, Channel Catfish Viruses Disease, Mychrobacteriosis.

Table 2. Fish Disease Symptom Data

No	Code	Symptom
1	G01	Reduced appetite
2	G02	Excessive mucus production
3	G03	Abnormal swimming
4	G04	Wounds on the gills are whitish
5	G05	Bulging eyes
6	G06	Fin hemorrhage
7	G07	Skin wounds oozing pus
8	G08	Bulging belly
9	G09	Fish appear limp
10	G10	Dark body color
11	G11	Red color of the mouth
12	G12	Fish appear to gasp on the surface
13	G13	Fish swim obliquely
14	G14	The outside of the eye is covered with a thin white membrane
15	G15	Fish appear to float to the surface
16	G16	fin color: ash, ash, white or pink;
17	G17	Wounds on some parts of the body and gills
18	G18	There are white spots on the body
19	G19	Gill color paled
20	G20	Fins and tail vibrate and curl
21	G21	White spots around the mouth and fins
22	G22	ulcer wounds on the body of the fish
23	G23	Increased respiratory frequency
24	G24	Fish gather in the production channel
25	G25	Peeling scales
26	G26	Swelling of the jaw
27	G27	Pale body color
28	G28	Swelling of the body

In table 2 there are 28 symptoms accompanying fish diseases, these symptom data are used in research by first consulting experts.

4.2. Relation of Disease and Symptoms

Table 3. Relation of Disease and Symptoms

No	Code	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
1	G01	✓	✓	✓		✓			✓		
2	G02	✓					✓		✓		
3	G03							✓	✓		
4	G04										
5	G05									✓	✓
6	G06		✓		✓	✓					
7	G07			✓							
8	G08						✓			✓	
9	G09							✓		✓	✓
10	G10			✓		✓	✓				
11	G11				✓						
12	G12										
13	G13						✓			✓	
14	G14		✓								
15	G15						✓				
16	G16					✓					
17	G17										
18	G18					✓					
19	G19										
20	G20					✓					
21	G21			✓			✓				
22	G22										
23	G23	✓						✓			
24	G24	✓									
25	G25				✓						
26	G26								✓		
27	G27		✓								✓
28	G28										

In table 3 can be seen the relationship between fish diseases and symptoms such as symptoms G01 (reduced appetite) associated with diseases P1 (Brainchiomycosis), P2 (Columnaris), P3 (Vibriosis), P3 (Vibriosis), P5 (White Spot), and P8 (Chilodonella).

4.3. Application of Rules Forward Chaining and Certainty Factor

Forward chaining method to calculate the final outcome of the disease based on the symptoms that appear. After getting the results, proceed with the calculation of the certainty factor value to determine the percentage of confidence in the results. This process aims to provide more accurate and reliable information in support of disease-related decision-making based on measurable levels of certainty.

Table 4 is the rule applied using the forward chaining method, namely there are 10 different rules for each existing disease. Rule 1 for White Spot disease, rule 2 for Brainchiomycosis, rule 3 for Vibriosis, rule 4 for Chilodonella, rule 5

for Tuberculosis, rule 6 for Columnaris disease, rule 7 for Enteric Red Mouth disease, rule 8 for Thricodonisiasis, rule 9 for Channel Catfsih Viruses Disease, and rule 10 for Mychrobacteriosis.

The expert first determines the value of each symptom, along with the value of each symptom where the value or weight is obtained using the equation applied Here are the values on the degree of confidence formed into the table.

Table 4. Rules Forward Chaining

Rule	IF	THEN
1	G00. G06, G10. G16, G18, G20	White Spot
2	G00. G02, G10. G23, G24	Brainchiomycosis
3	G00. G07, G10. G19	Vibriosis
4	G00. G02, G03, G26	Chilodonella
5	G02, G08, G10. G13, G15, G21	Tuberculosis
6	G00. G06, G21	Columnaris
7	G06, G10. G28	Enteric Red Mouth
8	G03, G09, G23	Thricodonisiasis
9	G05, G08, G09, G13	Channel Catfsih Viruses Disease
10	G05, G09, G28	Mychrobacteriosis

Table 5. Assess the expert's degree of confidence

Symptom	Code	MB - MD	CF (MB-MD)
Reduced appetite	G01	0.3 – 0.1	0.2
Excessive mucus production	G02	0.5 – 0.1	0.4
Abnormal swimming	G03	0.5 – 0.1	0.4
gills whitish	G04	0.3 – 0.1	0.2
Bulging eyes	G05	0.3 – 0.1	0.2
Bleeding on the fins	G06	0.3 – 0.1	0.2
Skin wounds oozing pus	G07	0.5 – 0.1	0.4
Bulging belly	G08	0.5 – 0.1	0.4
Fish appear limp	G09	0.3 – 0.1	0.2
Dark body color	G10	0.3 – 0.1	0.2
Red color of the mouth	G11	0.5 – 0.1	0.4
Fish appear to gasp on the surface	G12	0.3 – 0.1	0.2
Fish swim obliquely	G13	0.3 – 0.1	0.2
Fish floating to the surface	G14	0.3 – 0.1	0.2
fin color: ash, ash, white or pink;	G15	0.5 – 0.1	0.4
Wounds on body parts and gills	G16	0.3 – 0.1	0.2
There are white spots on the body	G17	0.5– 0.1	0.4
Gill color paled	G18	0.3 – 0.1	0.2
The tail fin is curved vibrating	G19	0.3 – 0.1	0.2
White spots around the mouth and fins	G20	0.3 – 0.1	0.2
Ulcer wounds in fish	G21	0.3 – 0.1	0.2
Increased respiratory frequency	G22	0.5 – 0.1	0.4
gathering in the dispensing channel	G23	0.3 – 0.1	0.2
Peeling scales	G24	0.3 – 0.1	0.2
Swelling of the jaw	G26	0.5 – 0.1	0.4
Pale body color	G27	0.3 – 0.1	0.2
Swelling of the body	G28	0.8 – 0.2	0.6

Table 6. Certainty Factor confidence degree value

Degrees of confidence	Weight
Not sure	0
Less Sure	0.2
A little sure	0.4
Sure enough	0.6
Believe	0.8
Very Sure	1

4.4. Manual method testing

Manual testing takes several samples of the data to be tested and then compares the results with the system. There are 5 samples with the steps in manual calculation as follows:

a. Thricodiniasis

It is known that gourami fish have three symptoms of Thricodiniasis, namely abnormal swimming, the fish appearing weak, and increased respiratory frequency.

Table 7. Expert and User Value Test Results Thricodiniasis

CF	Code	Symptom	CF Expert		CF User	CF(H,E)
1	G03	Abnormal swimming	0.4	×	1	0.4
2	G09	The fish looks limp	0.2	×	1	0.2
3	G23	Respiratory frequency increases	0.2	×	0.2	0.04

CFCombine (CF0. CF2 = CF1 + CF2 × (1-CF1)
CFCombine (CF0. CF2) = 0.4 + 0.2 × (1-0.4)
= 0.4 + 0.12
= 0.52 CF Lama
CFCombine (CF Lama, CF3) = 0.52 + 0.04 × (1-0.52)
= 0.52 + 0.01
= 0.53 CF Lama
CFCombine × 100%
0.53 ×100% = 53%

b. Mychobacteriosis

Mychobacteriosis is a disease that originates from susceptible bacteria in gourami fish. This disease has three symptoms, namely bulging eyes, the fish appearing weak, and swelling of the body. The following are the rules for Mychobacteriosis.

Table 8. Expert and user ratings for Mychobacteriosis disease

CF	Code	Symptom	CF Expert		CF User	CF(H,E)
1	G05	Protruding eyes	0.2	×	1	0.2
2	G09	The fish looks limp	0.2	×	0.2	0.04
3	G28	Swelling of the body	0.6	×	0.2	0.12

CFCombine (CF0. CF2) = CF1 +CF2 × (1-CF1)
CFCombine (CF0. CF2) = 0.2+0.04 × (1-0.2)
= 0.2+0.03
= 0.23 CF Lama
CFCombine (CF Lama, CF3) = 0.23+0.12 × (1-0.23)
= 0.23+0.09
= 0.32 CF Lama
CFCombine ×100%
0.32 ×100%=32%

The symptoms have been fulfilled and the conclusion is known in the form of a fact, namely that the fish is infected with Mychobacteriosis with a certainty level of 32%.

c. Channel Catfish Viruses Disease (CCVD)

Channel Catfish Viruses Disease is a special disease that infects catfish from children to adults. The symptoms of this disease are that the eyes look bulging, the fish looks weak due to being infected with the virus, and swelling of the body.

Table 9. Expert and user ratings for Channel Catfish Viruses Disease

CF	Code	Symptom	CF Expert		CF User	CF(H,E)
1	G05	Protruding eyes	0.2	×	1	0.2
2	G08	Stomach bulging	0.2	×	0.2	0.04
3	G09	The fish looks limp	0.2	×	0.6	0.12
4	G13	The fish looks lopsided	0.4	×	0.2	0.08

CFCombine (CF0.CF2) = CF1 +CF2 ×(1-CF1)
CFCombine (CF0.CF2) = 0.2+0.04 ×(1-0.2)
= 0.2+0.03
= 0.23 CF Lama
CFCombine (CFLama, CF3) = 0.23+0.12×(1-0.23)
= 0.23+0.09
= 0.32 CF Lama
CFCombine (CFLama, CF4) = 0.32+0.12×(1-0.32)
= 0.32+0.05
= 0.37 CF Lama
CFCombine ×100%
0.37 ×100%=37%

d. Columnaris

This disease is synonymous with white spots all over the mouth. Fish affected by this disease have a reduced appetite, the symptoms of columnaris disease are reduced appetite, bleeding on the fins, and white spots around the mouth and fins. The following are the rules for Columnaris disease.

Table 10. Test results of expert and user column values

CF	Code	Symptom	CF Expert		CF User	CF(H,E)
1	G01	Decreased appetite	0.4	×	1	0.4
2	G06	Bleeding on the fins	0.2	×	0.2	0.04
3	G21	White spots around the mouth and fins	0.2	×	0.4	0.08

CFCombine (CF0.CF2) = CF1 +CF2 ×(1-CF1)
CFCombine (CF0.CF2) = 0.4+0.04 × (1-0.4)
= 0.4+0.02
= 0.42 CF Lama
CFCombine (CFLama, CF3) = 0.42+0.08 × (1-0.42)
= 0.42+0.04
= 0.46 CF Lama
CFCombine ×100%
0.46 ×100%=46%

e. Chilodonella

Chilodonella is a disease that is susceptible to infecting tilapia in cultivation. This disease originates from parasites. Clinical symptoms that occur in tilapia are reduced appetite, excessive mucus production, abnormal swimming, and swelling of the jaw. As in the rules specified by Forward Chaining as follows:

Table 11. Test results of expert and user values for Chilodonella disease

CF	Code	Symptom	CF Expert		CF User	CF(H,E)
1	G01	Decreased appetite	0.2	×	1	0.2
2	G02	Excessive mucus production	0.2	×	0.2	0.04
3	G03	Abnormal swimming	0.2	×	0.2	0.04
4	G26	Swelling of the jaw	0.4	×	0.2	0.08

CFCombine (CF1,CF2) = CF1 +CF2 ×(1-CF1)
CFCombine (CF1,CF2) = 0.2+0.04×(1-0.2)
= 0.2+0.03
= 0.23 CF Lama
CFCombine (CFLama,CF3) = 0.23+0.04×(1-0.23)
= 0.23+0.03
= 0.26 CF Lama
CFCombine (CFLama,CF4) = 0.26+0.08×(1-0.26)
= 0.26+0.05
= 0.31 CF Lama
CFCombine ×100%
0.31 ×100%=31%

f. Testing methods through the system

The appearance of the system as a bridge for interaction between users and the system. The interface is made so simple that users can understand the use of the application well. Interface Testing, as previously explained, is how the system display is designed in the previous chapter, following are the results of the display on the system, which has several displays, namely the main page, guide page, information page and diagnosis page.

g. Main page display

The main page is the first page opened in the application. On this main page, several menus are provided, each menu has its own function.

Figure 3. Main page display

h. Guide Page

The guide page contains how the application is used by users. On the guide page, page descriptions are included which can only be read to understand the application.

Figure 4. Guide page

i. Diagnosis Page

The diagnosis page is the most important menu in this application. This menu is a means of diagnosing freshwater fish diseases.

Figure 5. Display of the diagnosis page

j. Information Page

The information page explains various information about the sources of different fish diseases as well as the control of several fish diseases

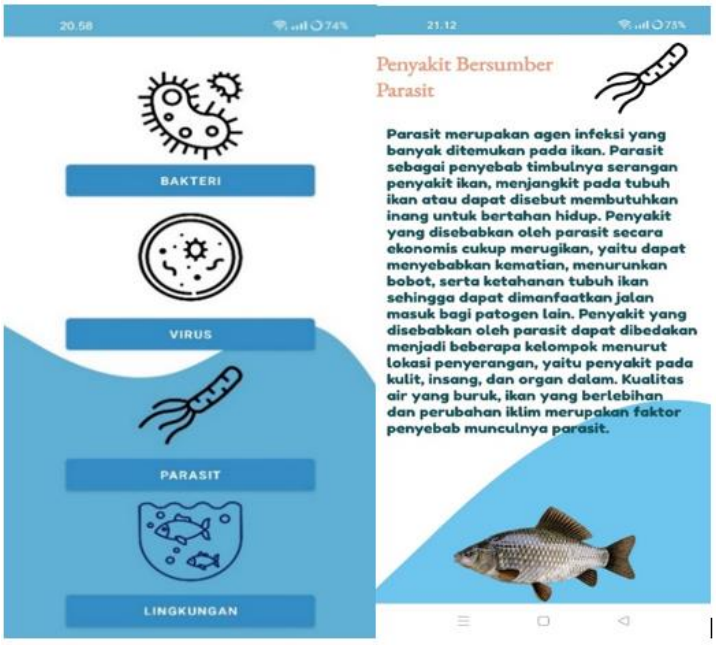

Figure 6. Display Information Page

5. Conclusion

Based on research results and existing problems. Every result in the system that is tested and implemented can run well according to the method. Research carried out by building an expert system can be concluded that the system is able to apply the Certainty Factor method and the Forward Chaining method so as to provide output in the form of fish disease diagnosis results. Test results are carried out manually and implemented on the system. When carrying out manual calculations for one of the fish diseases, namely Enteric Red Mouth, using the Certainty Factor method, the results were 65%. This manual calculation was compared with the implementation in the system and the same results were obtained. In the research carried out, the system built was limited to two application methods and two types of freshwater fish which were diagnosed based on the problem. The system built, along with its interface, can run well and as expected through testing methods

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